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ABSTRACT

This guide is one of a set of 10 science guides, each covering a separate grade in Manitoba, together covering kindergarten through grade 9. The guides have been designed to provide a framework for building scientific concepts and developing the learning of process skills. They replace an earlier set of guides dated 1979. Each guide is essentially the same through the first 16 pages, after which the core units vary appropriately for each academic level. Section 1, "Objectives of the Curriculum," includes the aims of the program and a discussion of the role of science in general education. Section 2, "The Learner," discusses the variety and nature of children, misconceptions in science, and girls in science. Section 3, "The Teaching Environment," includes program implementation, computers in science, time allotment for the science program, and enrichment activities. Section 4, "Evaluation," discusses student evaluation and safety and provides sample evaluation techniques. Section 5, "Attitudes and Skills," contains subsections on attitudes and values, science/technology/society (STS), environmental education, sustainable development strategies, process development, and problem solving. Section 6, "Scope and Sequence," discusses process development, attitude development, a general program overview K-4, and concept maps for the grade covered. A suggested minimum materials list for the K-4 Science program is also included. The conceptual structures, objectives, activities, and references for the core units are provided. Three themes and units within those themes which are carried through the K-4 program include: (1) environmental interdependency and interaction--living and non-living organisms (kindergarten); (2) matter and energy--properties of objects (kindergarten); and (3) earth, time and space--size, position, and time (kindergarten). A copy of a teacher response questionnaire for the K-9 science program of studies is appended. (KR)

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Manitoba Education and Training

1991

science: kindergarten

interim guide

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science: kindergarten

interim guide

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manitoba education and training

1991

ISBN 0-7711-1005-7

This guide has been prepared by Manitoba Education and Training to meet the needs of kindergarten students. This guide has been revised on the basis of feedback from teachers during the period of 1988-89. It has been designed to articulate with the new 1-9 Science guides and to provide a framework for building scientific concepts and developing the learning of process skills. This guide may be used in September, 1991, in place of the previous (1979) guide.

The Department of Education and Training wishes to acknowledge the contributions of the following members who constituted the committees responsible for the development of this guide.

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OBJECTIVES OF THE CURRICULUM

AIMS

"Science is a search for understanding" through a systematic and cumulative exploration of the natural phenomena of the universe.[1]

Teachers should strive for balance in the science program, and should especially try to make processes development at least as important as content.

The K-4 science program includes the following:

- promoting of attitudes as part of scientific literacy, including:
  - curiosity to explore, ask questions, actively investigate;
  - inventiveness in generating new ideas, using equipment constructively, suggesting new experiments;
  - critical thinking to justify conclusions or predictions and changing ideas in response to evidence or logical reasons;
  - persistence in maintaining an active interest in a problem.
- understanding and use of scientific processes.
- understanding and applying knowledge to practical situations.
- understanding the interactions of science, technology and society by applying them to their environment.

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[1] H. Grunau, Faculty of Education, University of Manitoba.

Science education provides experiences that are relevant to children on an immediate and personal level, developing attitudes, skills and knowledge for use today and in the future.

Exploration of the above areas, and helping children to apply the ideas in practical situations, provide for use of higher level thinking processes, which in turn provide for self-motivated, independent, concerned participants in society.

ROLE OF SCIENCE IN GENERAL EDUCATION

Children initially examine their environment through concrete experiences within a broad range of interests. One of the important functions science shares with other areas of study is the development of basic processes of classifying, measuring, using space-time relationships, inferring and predicting, and applying these processes to the world around them.

The young child lives in and views an integrated world and this leads to many opportunities for integrating subject areas.

Through interaction with materials in simple group activities, children are able to develop listening, reasoning, and group participation skills. In centre based activities, small groups and individuals develop written communication, graphing and measurement skills, independence and confidence. Children need opportunities to concretely explore and understand relationships in this multi-dimensional world. Science can "spark" interest in all areas of study. An example of the Kindergarten science concept "plants require certain things to grow" is outlined to show one way of integrating objectives from other subject areas i.e., the use of centres.

VARIETY AND NATURE OF CHILDREN

The emphasis of psychologists such as Piaget, Bruner, Ausubel, and Gagne is placed on experience with concrete materials and the child's need to be involved in actively structuring his or her learning. According to Piaget, children pass through an ordered series of developmental stages, believed to be controlled by the maturation of the brain and the nature of a child's experience. These stages aren't limiting, as all children have different experiences in different areas.

Appropriate activities for Piaget's various stages are:

2 to 6 years - Pre-Operational

Being able to manipulate and carry out physically the actions he/she may not be able to carry out mentally. Exploration and experiences of trying things out to see the result enables them to link cause and effect. An activity is repeated several times, if desirable.

7-12 years - Concrete Operational

Exploring a wide range of problems in real situations and gradually coming to see patterns. Planning and carrying out investigations or methods of problem solving which he/she has devised; discussing results and learning from errors about the variables which should be controlled. Putting problems in concrete terms where doing can support thinking.

13-15 years - Formal Operational

Drawing conclusions from previous learning and applying principles to new problems. Testing ideas by planning experiments which control all the necessary variables. Developing abstract ideas about properties of materials; devising and using theoretical models for predicting and explaining.

Taking this into account, the science program must be experience-based and activity-centered. Concrete experiences are essential for the pre-operational and concrete-operational stages in order to meet changing needs, abilities, interests and learning styles of the children. The science program must give children time, space, and encouragement to explore science and consolidate learning inside and outside the classroom.

MISCONCEPTIONS IN SCIENCE

Misconceptions represent complete systems of explanations which are conceptually wrong. They are usually personal and constructed from one's experiences. K-4 children harbour many misconceptions in science, partly due to their limited experiences and stage of mental development. These misconceptions may be adjusted by teaching science through a wide usage of concrete and relevant experiences, and adequate, appropriate discussions of findings in a non-threatening environment. Some examples of misconceptions are:

1. that an object will float in shallow water but will sink in deep water;

2. that because plants need sun, food and water, the plants will flourish if you give them direct 24 hour sunlight, and as much water and fertilizer as possible;

3. that the metamorphosis of mealworms will result in only more mealworns with the misconception expressed by the question: Who put the beetle in the bottle?

Teachers of science who want to modify their children's conceptual framework need to challenge the children's alternative conception. Some guidelines for teachers are:

- ask children for their ideas, respect the ideas and explanation offered;

- guide the students into developing experiments or experiences that will allow them to test their ideas;

- encourage the children to discuss and resolve the discrepancies between their initial predictions and the new evidence;

- always listen to see whether students have ad-adjusted their conceptual framework after the experiment or experience.

GIRLS IN SCIENCE

Research shows that girls are biased against areas of physical science through home, media and school experiences at as early an age as six years. Girls have already developed opinions about appropriate behaviours and occupations for one or the other sex by this age.

"A girl might aspire to be a lawyer but expect to be a typist in a law office; ....she might aspire to be a doctor but expect to be a nurse."[2]

Teachers must:

- consciously model enthusiasm and involvement in science to motivate children to participate and become involved in science;

- offer bias-free resources (those that give equal consideration to both sexes in career and life-style portrayal);

- have equal expectations for boys and girls (studies have shown that boys receive considerably more teacher feedback, occupy more physical space, are more critical of girls and of each other, and generally assume the leadership role in a mixed group);

- encourage both boys and girls in planning, recording, setting up experiments, using equipment and other learning opportunities;

- encourage projects which recognize skills and interests of both sexes and discourage put-downers or devaluing of "female" interests by male students.

[2] "Who Turns the Wheel?", Science Council of Canada, January, 1982, p. 82.

PROGRAM IMPLEMENTATION

The school administrators have an important leadership role in science program implementation. This role includes the following directions or activities:

- encouraging a shared management of implementation for the science program by providing opportunities for cooperative planning.

- monitoring the degree of implementation and the needs of staff.

- determining the implications of the curriculum for staff training and facilities.

- providing easy access to the materials and facilities needed for the program. This will include the provision of sufficient funds which would be used to purchase necessary equipment and materials as the need arises.

Some implications of the science program for implementation into the school include:

- like in the previous curriculum, the new program emphasizes the development of science processes and concepts. The use of activities to develop these processes and concepts will affect teaching methodology and evaluation methods.

- the K-4 science program has introduced new segments within the program: Flotation: A Property of Matter, life cycles, a consolidation of the previous K-1 program, application of science and Implementation may require specific work with teachers in order to increase their knowledge and teaching methodology base for these units.

- the science program suggests some ways to integrate some mathematical and language arts skills into the structure of some topics. Developing additional units whereby mathematics and language skills are an outcome of science units and activities may be required.

Evaluating the effectiveness of the science program consists of judging its worth on the basis of valid information about how well the achieved curriculum meets the objectives of the intended curriculum. Many sources of data should be searched to provide a basis for the evaluation, such as:

- evaluation of student achievement;

- analysis of the methods of evaluation;

- teaching strategies and emphases upon program goals.

Additional sources of information about program evaluation are:

1. Mechling, Kenneth R., "Taking Charge: How Principals can Improve School Science Programs, "Principal, January 1983, pp. 16-21.

2. Mechling, Kenneth R. & Oliver, Donna L., "Activities, Not Textbooks: What Research Says About Science Programs.", Principal, March 1983, pp. 41-43.

3. Mechling, Kenneth R. and Donna L., Promoting Science Among Elementary Principals: Handbook I-IV, National Science Teachers' Association, 1742 Conneticut Avenue, N. W., Washington, D.C., 1983.

COMPUTERS IN SCIENCE

Computers are a recent addition to the learning environment. They offer extensions and support for science learnings. Computers are not a primary means of delivering science education or a replacement for direct investigations. However, they can enrich the science program and provide individual and practice work in a number of ways. These include:

- developing an awareness of the role of complex technologies in society.
- simulations;
- problem solving exercises.

Computers are a way of life in the future for children.

TIME ALLOTMENT FOR THE SCIENCE PROGRAM

Recommended time allotments for K-3 science are 15 minutes daily or 75 minutes weekly and for grades 4-6 are 30 minutes daily or 150 minutes weekly. Time allocations for each unit can vary but teachers should ensure that students are given sufficient time to cover the entire program for any given year.

ENRICHMENT ACTIVITIES

The activities included in the K-4 program provide learning experiences that help students understand and interpret the world in which they live. The activities which appear under the heading of enrichment are intended as extensions to the regular program. These activities have been selected in order to allow students to explore some areas at greater depth.

STUDENT EVALUATION

The general purposes of student evaluation are to provide:

- students with an understanding of their development and needs relative to the program;
- teachers with a basis for planning necessary changes in teaching strategies and the curriculum;
- information for parents and administrators.

Thus, evaluation should be related to program objectives, and in the K-4 science program, it should relate to science processes and attitudes in addition to content. Further, evaluation must be continuous and use a variety of approaches.

Informal observation techniques whereby teachers observe individual and group interactions in an activity can help to determine needed skill development of students and techniques which can be used to improve their skills.

Formal techniques include achievement and performance tests, checklists of processes, attitudes, and manipulative skills and the examination of products such as reports or projects. Although achievement tests (pencil and paper variety) are generally considered to evaluate content most effectively, other objectives of the program such as science processes and attitudes can be evaluated by written and performance items, checklists and other means.

SAMPLE EVALUATION TECHNIQUES

A. Processes Checklist

Monitoring student achievement in science processes may be helped by observing student behaviours in applying the processes. The student should be able to carry out the processes noted in the objectives in each science unit in the curriculum, at the appropriate grade level. A checklist from these objectives can be made, the concepts are taught, and then the process involved can be checked off for those students who show mastery. Samples of some student behaviours are:

Process	Behaviour
Observing	. Identifies properties of an object with and without sight; uses a variety of senses.
	. Selects objects according to special properties.
	. Identifies changes in an object and parts of a system.
	. Places a greater emphasis upon quantitative observation (estimating, measuring).
	. Describes motion of an object relative to a reference point.

Communicating	. Reads and constructs bar graphs, simple tables, and charts.
	. Interprets accurately information and instructions presented orally, in writing, and in graphic or pictorial form.
	. Reports information concerning an investigation; e.g., states the problem, records the results, and reaches a conclusion.

B. Scientific Attitude Checklist

Attitude	Behaviour
Questioning of All Things	. Shows curiosity with objectivity and open mindedness.
Searching for Data and Their Interpretation	. Looks for support for their ideas.
Demanding Verification	. Seeks data and information to validate observations or explanations.
	. Questions conclusion based on incomplete data.
Respecting Logic	. Modifies views in the face of new evidence
	. Shows respect for the ideas of others.

C. Performance Items

These items may be used individually or in a group (station) setting to test process and manipulative skills at the grade 3 level. For example:

Birds

Purpose: to test observing/classifying, interpreting skills.

Procedure: Pictures of two birds are provided and children are asked to see what is different about them and how they are different. Use only observable differences, i.e. colour/pattern, size/shape, environment.

Marbles in Tubes

Purpose: to test observing, inferring, interpreting data, explaining physical phenomena, safety/manipulative skills.

Procedure: Three covered tubes in upright positions, each containing liquids of different densities (i.e., water, vegetable oil, methyl alcohol) and a marble. Tell students that the marbles are all the same size and weight. have students examine the tubes and turn them upside down. Ask students to write down three things they observe and to propose a reason for the marbles taking different times to fall.

SAFETY AND SCIENCE[3],[4]

The K-4 curriculum contains few safety hazards to children. Teachers should establish proper classroom behaviour, conducive to safe operation. Common sense is the best guide to follow in the area of safety. Manageable group size and a well-planned lesson will allow students to work without confusion. By showing concern for safety, the teacher can help the students develop a positive attitude in regard to safety.

General Safety Guidelines

- At the beginning of the science class, remind the students about the applicable safety precautions they must take during the lesson.
- Give clear, complete directions before allowing the students to begin any activity.
- Instruct students not to taste or touch substances or materials without permission.
- Stress the importance of not touching one's eyes, ears and mouth while working with plants, animals and chemicals.
- Allow time for clean-up and proper storage of materials.
- Closely supervise your students at all times.
- Familiarize students with first aid, fire drill and other emergency procedures.

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[3] "Safety in Science." Department of Education, 1982.

[4] "Safety in the Elementary Science Classroom," National Science Teachers' Association, 1742 Connecticut Avenue, N.W., Washington, D.C., 20009.

Some tips on animals and plants are:

Animals

- Check for student allergies.
- Obtain animals only from a reputable dealer.
- Keep in suitably sized enclosures.
- If animal is in poor health, remove it from the room until a veterinarian has been consulted.
- Always wash hands after handling the animal.
- Keep an animal only for as long as it is a meaningful part of a classroom program.

Plants

- Check for student allergies.
- Be aware that parts of some plants are poisonous, i.e. leaves - rhubarb, dieffenbachia;
  sap - poinsetta.
  seeds - castor beans

ATTITUDES AND VALUES

One of the greatest achievements of science is to have developed scientific methods that work almost independently of the people who are conducting the scientific investigations. Thus, children learning science must also learn many attitudes toward science such as:

- objectivity;
- open-mindedness;
- fairness;
- accuracy;
- thoroughness;
- perseverance;
- curiosity;
- creativity;
- risk taking.

The rudiments of these scientific attitudes can be learned very early in school, based on a gradual understanding, rather than direct teaching.

SCIENCE, TECHNOLOGY AND SOCIETY

School science is sometimes understood by students to be an end in itself. A science, technology and society (STS) emphasis attempts to help students understand the applications of science and how this relates to the world around them, making science much more relevant.

For the K-4 level, the major STS emphasis is the child's home, community environment; expanding to include cities, provinces and beyond.

The methods for incorporating STS are varied. One approach is to develop a science concept first, followed by applications, i.e. introduce the concept of heat insulators and later apply the concept by testing house insulation or designing ice-cube insulators. Another approach is to introduce the application first, and conclude with the basic science concept, i.e., Discuss how we keep our house warm in winter, or why do people replace old windows. This is the application of the science first and through testing materials, the students will conclude with the basic concepts of insulators.

Overall, it is suggested that STS goals should receive some 15-20% of the total emphasis. Some units and/or parts of units in the curriculum lend themselves more to STS activities and discussion than others. This guide marks some STS objectives/ activities with two asterisks (**) beside it. Teachers should feel free to find or develop their own examples.

ENVIRONMENTAL EDUCATION

Concerns for the environment have become so important that teachers need to be aware of imparting these values to children by example as well as by formal teaching. Such environmental values include:

- responsibility for living organisms;
- consideration for others;
- interaction with the environment in a responsible manner;
- concern and care for the environment.

Values taught through science education transfer well to life outside the classroom, developing environmentally alert individuals capable of making well-reasoned interpretations and motivated to taking responsibility for their decisions throughout life.

SUSTAINABLE DEVELOPMENT STRATEGIES

Sustainable development is the process of maintaining our natural heritage. It is important that students are made aware of the need for judicial use and management of our natural resources. The students are the stakeholders. They need to be informed about environmental concerns and the economic devastation which occurs due to a lack of environmental protection.

A Sustainable development strategies (SDS) emphasis in the science program will allow students to identify the areas in which environmental damage is taking place and to explore methods by which the environment can be protected. This SDS emphasis begins in kindergarten and continues throughout the entire science curriculum.

Some units lend themselves more to SDS activities and discussions than others. Teachers are encouraged to develop and foster SDS awareness whenever the opportunity arises.

This guide identifies the SDS related objectives with three asterisks(***) beside them.

PROCESS DEVELOPMENT

Processes are intellectual skills, developed and used both in science and other areas of study. When children experiment with materials and examine ideas both processes and concepts are being developed and used. Observation and classification skills are important to the development of more complex processes such as interpreting data and are therefore classified as basic processes. These basic processes should begin to develop from early experiences. Experimenting and controlling variables are termed integrated processes and can usually be more effectively learned by children in the late concrete and formal operational states. Each process, in turn, consists of a series of levels of difficulty, i.e., the process of observation varies from the skill of describing an object in terms of a single property to identifying the object in terms of its many properties. The basic processes are gradually developed from early childhood through grade four. The integrated processes are stressed at higher levels, but all processes can be informally introduced to young children through simple investigative situations presented and directed by the teacher.

It should be noted that many of the main processes often include other activities that reflect various aspects of the process:

- observing includes identifying;
- classifying includes comparing and ordering:
- communicating includes describing and graphing.

Observation

Observing is one of the basic process skills of science. It involves obtaining information about objects, situations or events using the five senses. Observation may be qualitative or quantitative in nature. Observing provides both a basis for new inferences or hypotheses and a tool for testing existing inferences and hypotheses.

Measurement

Measuring is the process of determining the dimensions or quantity of an object or event. It usually involves comparison of size, volume, mass, temperature and time using non-standard/standard units.

Classifying

This process is the grouping of objects, concepts, or events on the basis of some observable properties in order to show similarities and/or interrelationships.

Inferring

Inferring means suggesting more about a set of conditions than is observed. Inferences are based upon observed data and past experience. Inferences may evolve from both direct and indirect evidence and are modified on the basis of new evidence. An example of inference: "to infer the identity of objects on the basis of observation of shadows".

Communicating Data

This is a process that occurs between the observation stage and the interpretation stage. It usually involves the organization of "rough" data into a more compact and meaningful way (ordering, comparing), depicting the data pictorially or graphically, and processing data mathematically (averaging, finding slopes) in order to facilitate interpretations.

Predicting

Predicting is a forecast about future events based on previously obtained data. Predictions can be made on the basis of ordered data or extrapolation beyond an observed pattern of events. An example of prediction: "to predict the consequences of changes in an animal habitat".

Hypothesizing

Hypothesizing is an educated guess about an expected relationship between two variables in an attempt to explain a cause and effect relationship. The hypothesis should be testable.

Recognizing and Identifying a Problem

This process involves recognizing and focusing on a problem that can be investigated, making assumptions about possible variables, and the ability to narrow down the question under investigation in order to work towards a solution.

Identifying and Controlling Variables

This process involves deciding which variables will influence the outcome of an experiment or event and deliberately controlling all recognized variables in a systematic manner. This combination of relationships (system) consists of a manipulated (independent) variable which is changed in a systematic way, corresponding changes in an observed responding (dependent) variable and all other variables are held constant (controlled). An example is a pendulum system where the time of swing (responding) is affected by the pendulum length (manipulated) and other variables such as mass of the bob and arc of the swing are kept constant.

Designing an Experiment

Experimenting is a cause and effect test between two variables. All processes may be involved. This may begin with setting a problem to be solved identifying a variable to be controlled, making operational definitions, devising the test to be carried out and finally to follow the prescribed procedure.

Interpreting Data

Interpreting is the process by which sense is made out of the observations in the form of inferences, generalizations or explanations. Thus, selecting data which supports inferences, identifying a general trend, and stating a conclusion or relationship are integral parts of this process. An example is: "state the average growth rate of bean plants."

Operationally Define

This is a process whereby objects or events are defined in a way which can be tested or observed such as: "When I join copper wires, a bulb and a dry cell in this way, a bulb will light up.

Using Space/Time Relationship

All objects occupy points in space at a given point in time. This process concerns spatial relationships and the ability to describe such things as shape, symmetry, direction, position and spatial arrangement, and speed.

PROBLEM SOLVING

Problem solving is a familiar teaching/learning approach which lends itself to science teaching. Problem solving includes:

- recognizing problems;
- discussing or thinking about solving them;
- trying out one solution;
- assessing the effectiveness of the solution;
- possibly modifying the solution in the light of experience.

The approach can be used to help children understand the world of human endeavours through practical problem-solving activities, involving using and discovering science skills in conjunction with "design and make" activities.

Problem solving exercises can vary considerably in content and in the processes and strategies employed:

- exercises which are of a technological nature where children are asked to design, construct, test and evaluate a system;

- exercises designed to carry out a scientific investigation;

- decision making exercises where children discuss a problem and come up with their own solution (role playing, games, simulations).

Preferences should be given to activities that involve a problem-solving approach and which:

- encourage creativity and inventiveness in designing and making 3-dimensional models which achieve a given task;

- cause students to learn or reinforce concepts relating to energy, materials and their properties, structures, forces, speed, measurement, accuracy, stability and control;

- give opportunities to develop manipulative skills with simple tools and range of materials;

- develop communication skills within and between teams and adults including drawing and display of ideas and achievements;

- involve some element of planning and organization.

Problem solving should be a regular part of the science program. This guide marks problem-solving objectives/activities with one asterisk (*) beside it.

SCOPE AND SEQUENCE

Process Development: When a process is introduced at an early stage, it should be developed and maintained in subsequent years.

PROCESS/GRADE	K	1	2	3	4
Observing	I	D	D	E	E
Measuring	I	I	D	D	E
Classifying	I	I	D	E	E
Inferring	I	I	D	E	E
Communicating	I	I	D	D	E
Predicting	I	I	D	D	E
Recognizing a Problem	I	I	D	D	E
Controlling Variables			I	I	D
Hypothesizing				I	D
Interpreting Data			I	I	D
Operationally Define			I	D	D
Design Experiments			I	I	I

Note:

I - Introduce processes using primarily teacher input.
D - Develop processes with less teacher input.
E - Extend processes to become more student controlled and directed.

ATTITUDE DEVELOPMENT

When an attitude is introduced at an early stage, it should be developed and maintained in subsequent years.

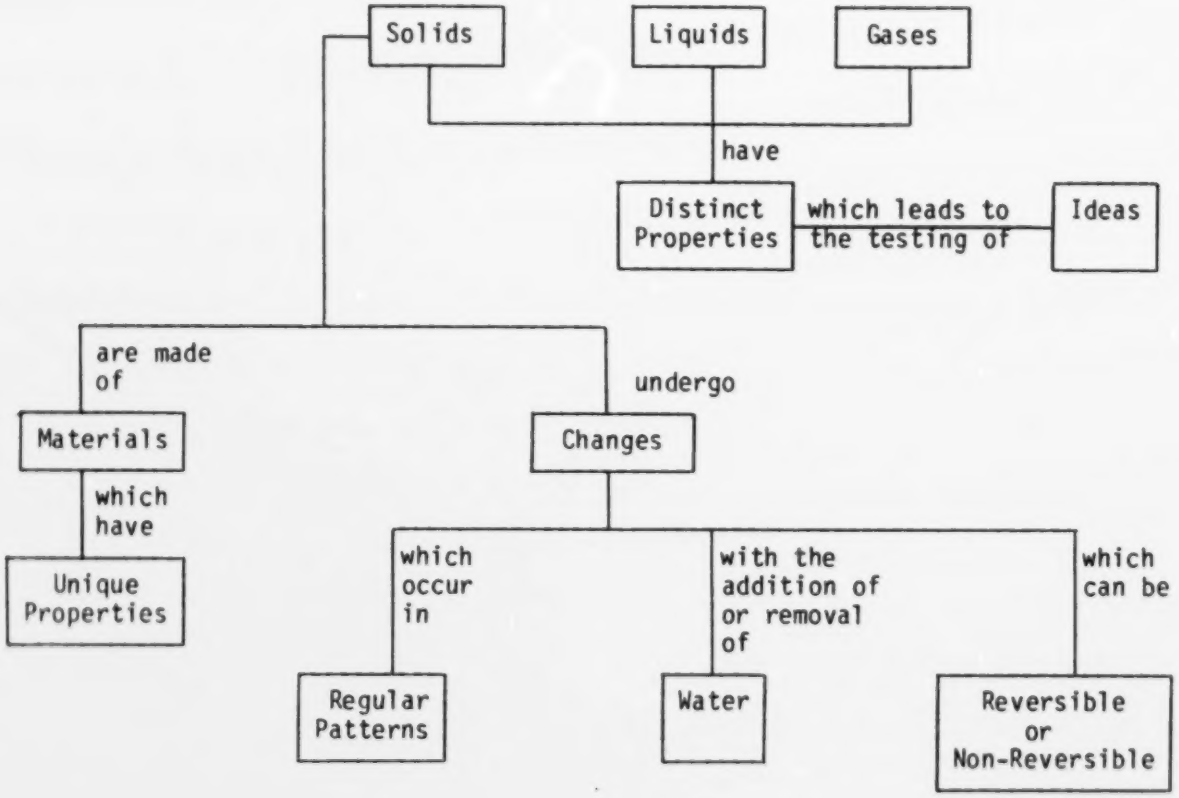
ATTITUDE/GRADE	INTRODUCTORY GRADE
Appreciate all living things.	K
Be committed to good animal care.	1
Be aware that animals can cause allergic reactions.	1
Value differences and similarities among humans.	1
Appreciate the adaptive value of some animal behaviours.	3
Recognize the need for safety in all activities.	K
Recognize the need for standard units and references.	1
Appreciate the need for verification.	1
Develop curiosity about natural events.	2
Recognize the need for accuracy in measuring.	2
Recognize that predictions can be made as a bais of valid evidence.	2
Seek plausible hypotheses to interpret findings.	4
Recognize the need for an empirical test as a basis for judging hypotheses.	4
Respect the importance, order, and beauty of the environment.	2
Recognize the need for man's care of the environment.	2
Recognize the importance of uses of different energy sources.	3
Develop an interest in learning about the universe.	3
Recognize the need to control sound in the environment.	4
Appreciate the technology of communication.	4
Appreciate the technology of electricity.	4
Appreciate the power of geological forces.	4
Recognize the dependence of man upon geological forces.	4
Recognize the importance of water as a resource.	4
Recognize the need to control and handle water wisely.	4

General Program Overview

THEME	K	1	2	3	4
Inter-Dependency and Interaction	Living and Non-Living Organisms	Animals are Living Organisms --- People are Living Organisms	Living Organisms in the Environment	Life Cycles	Population Interaction
Matter and Energy	Properties of Objects	Properties of Matter	Flotation: A Property of Matter	Energy, Heat and Temperature --- Changes in Matter	Electricity --- Structures --- Sound
Earth, Time and Space	Size, Position and Time	Comparing and Measuring Events	Light and Shadows --- Measuring Time, Objects and Position	Sun, Earth and Moon --- Air and Air Pressure	Water and Land

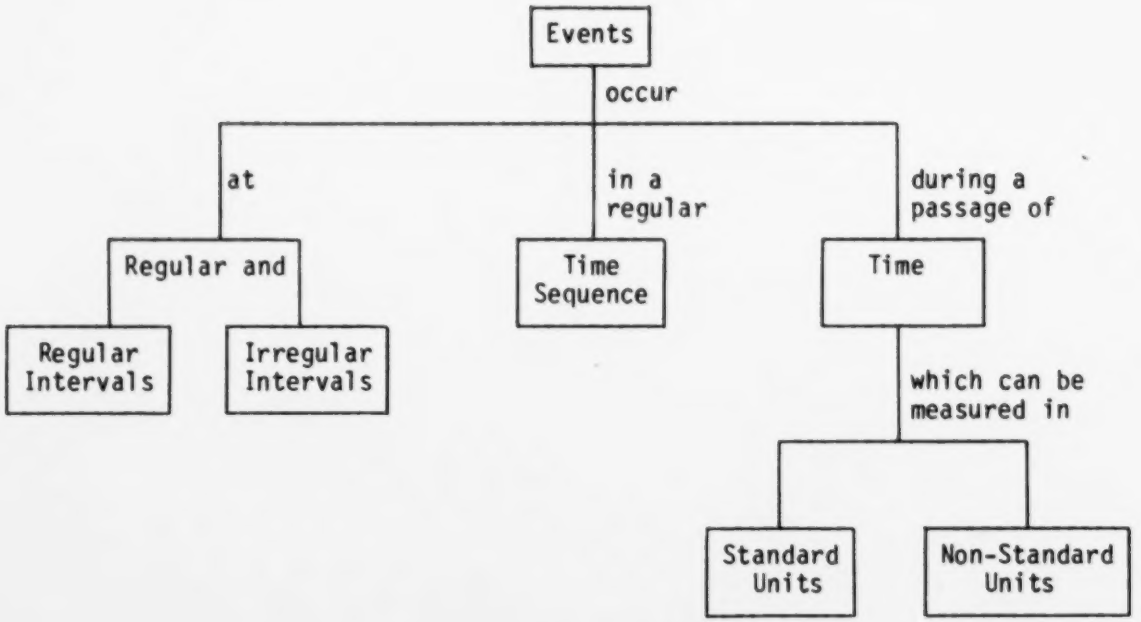
GRADE ONE

CHANGES IN MATTER AND ENERGY: PROPERTIES OF MATTER



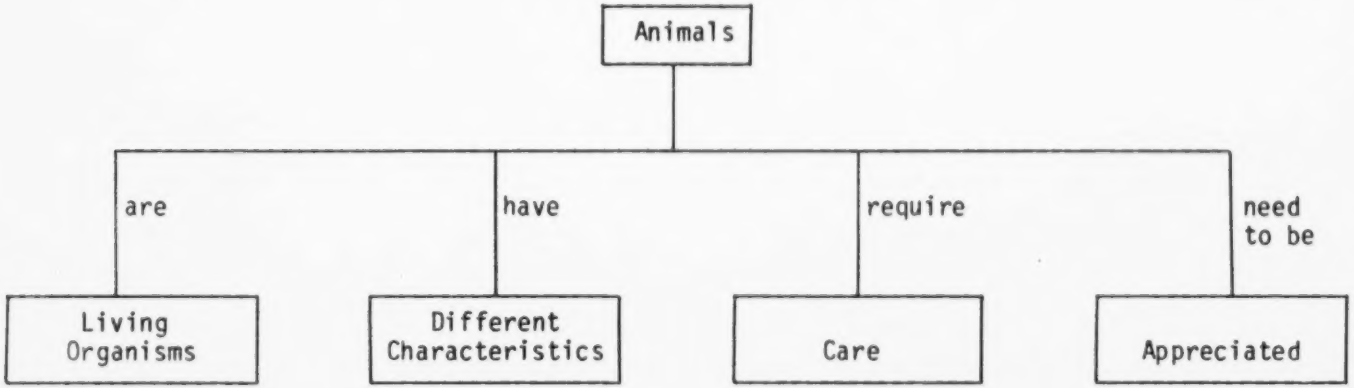
GRADE ONE

EARTH, SPACE AND TIME: COMPARING AND MEASURING EVENTS



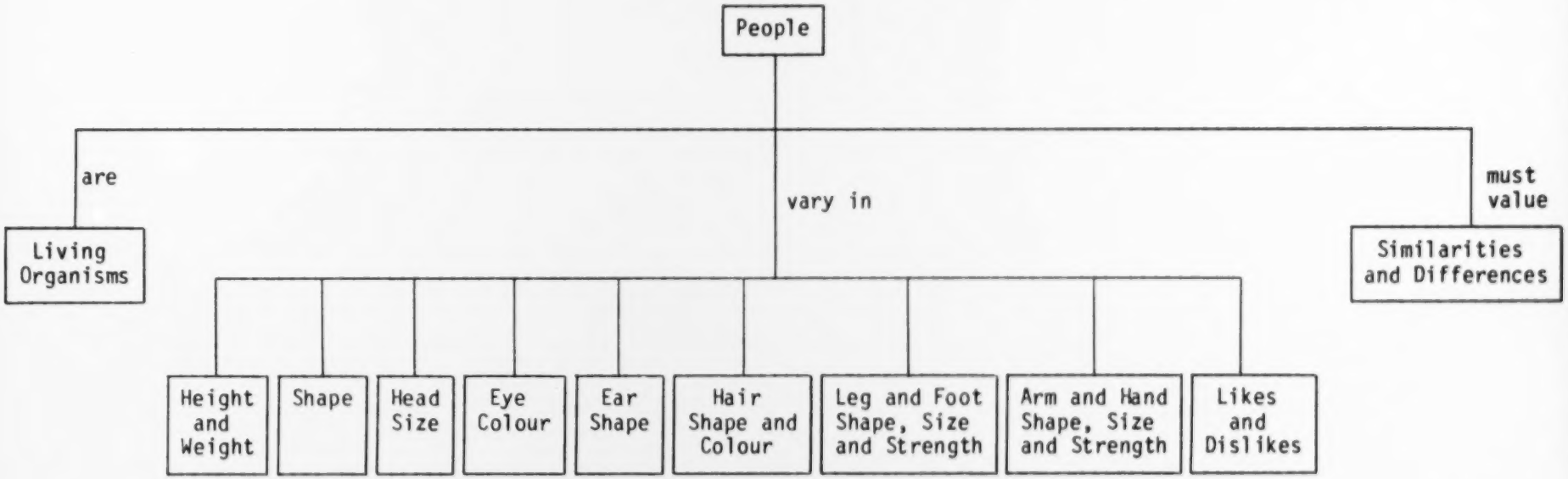
GRADE ONE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: ANIMALS ARE LIVING ORGANISMS



GRADE ONE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: PEOPLE ARE LIVING ORGANISMS



MATERIALS LIST

This is a suggested minimum list for the K-4 Science program. Many other items should be readily available at school or in the home. Teachers should be advised to review the units so that locally available material may be obtained in advance. A petty cash fund needs to be available in order that purchases may be made on an ongoing basis.

Basic Materials

- pop bottles (glass)
  (plastic - 500 ml, 1 litre, 2 litre)
- plastic containers and lids in all sizes
- egg cartons
- trays of assorted sizes
- cloth of all textures, colors, and materials
- nylons and panty hose
- newspaper
- jars of all sizes with lids
- tin cans of all sizes
- pine cones, bark, twigs
- popcorn kernels
- food colouring
- a variety of woods
- a variety of sandpaper
- coins
- milk cartons
- alka seltzer tablets
- sponges
- assortment of food and cooking items
- crackers, orange juice crystals, detergent, spaghetti, macaroni, salt, sugar, sugar cubes, baking powder, vinegar, flour, syrup, cornstarch, vegetable oil, molasses, dish detergent.
- popsicle sticks
- large and small graph paper
- wax (paraffin wax)
- vegetable oil, molasses, dish detergent
- an assortment of string
- an assortment of wool
- waxed paper
- aluminum foil
- plastic wrap
- paper towels
- kettle
- pie plates styrofoam and tin
- insulated wire (copper)
- toilet rolls
- gravel
- sand
- ping pong balls
- cardboard of all sizes and thickness
- plastic combs
- tooth picks
- cereals
- cotton balls
- threads
- an assortment of nails
- fossils (plastic models can be purchased)
- pulleys single and double
- index cards
- pictures
- balloons
- latex gloves
- straws
- spoons
- elastic bands
- thumbtacks
- paper clips

- straight pins
- candles
- dry cells
- light bulbs (miniature)
- scale (kg)
- magnets
- magnifying glasses
- fixed pan balance
- aquarium
- variety of seeds
- plasticine
- meter stick
- tape
- tape measure
- weights (g)
- graduated cylinder
- beakers
- medicine droppers
- test-tubes
- thermometers
- rubber stoppers
- corks
- glass tubing
- filter paper
- marbles
- baggies
- paper towels
- mirrors
- steel wool
- washers
- styrofoam cups
- paper cups
- clock (with second hand)
- markers
- drinking straws

SPECIFIC MATERIALS

Kindergarten

1. attribute blocks
2. terrarium
3. bulbs (for planting)
4. soil

Grade One

1. attribute blocks
2. logic sets (trees, vehicles, etc.)
3. egg beater
4. metronome (if available)
5. graph paper
6. bathroom scale

Grade Two

1. graph paper
2. 30 cm. ruler
3. flashights (different sizes)
4. light bulb and socket
5. chart paper

Grade Three

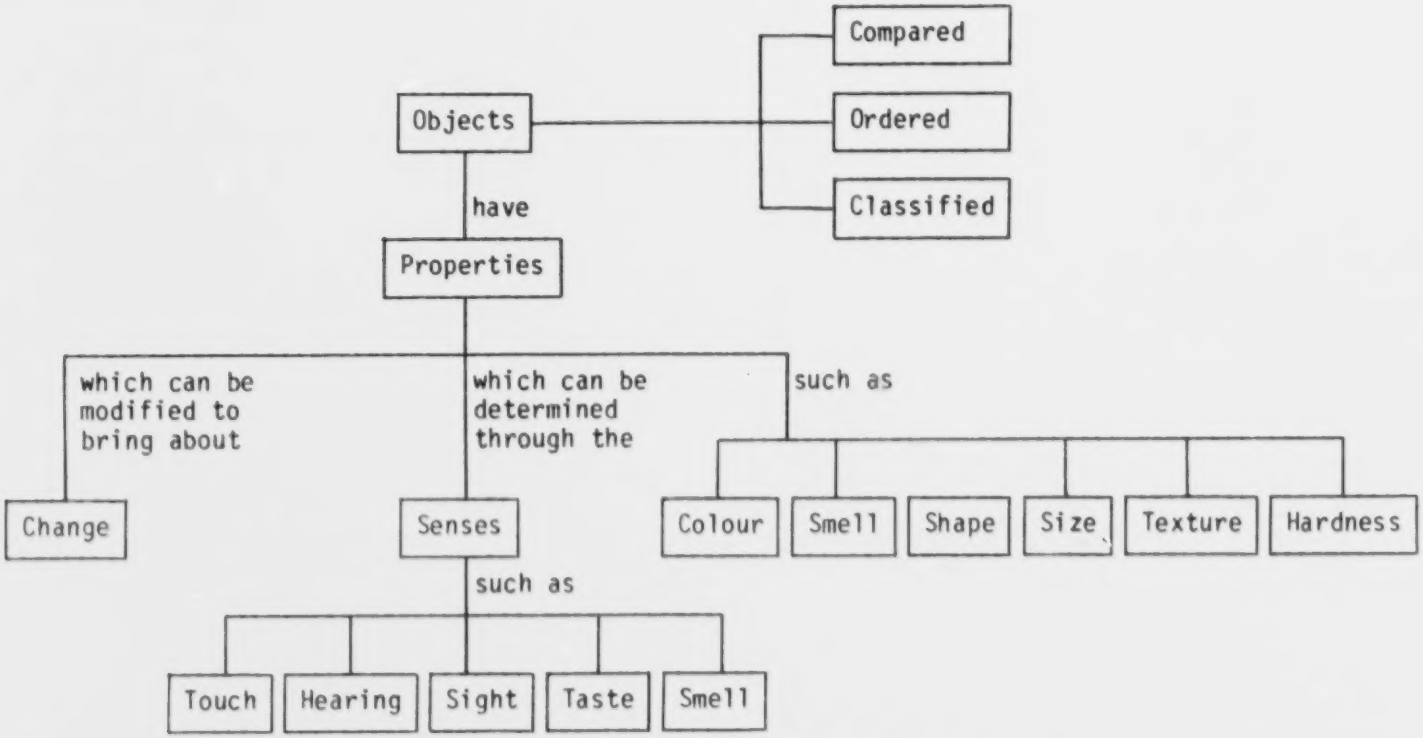
1. light bulb and socket
2. ball and ring apparatus
3. rubber tubing
4. meal worms
5. beetles
6. earthworms
7. glass flask
8. wax (paraffin)

Grade Four

1. nichrome wire
2. sockets (for miniature light bulbs)
3. alligator clips
4. fine steel wool
5. tuning fork
6. slinky
7. ticking clock
8. microscope slides
9. cover slips
10. microscope
11. prepared animal cells
12. iodine
13. skeleton set

KINDERGARTEN

CHANGES IN MATTER AND ENERGY: PROPERTIES OF OBJECTS



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KINDERGARTEN

TITLE: CHANGES IN MATTER AND ENERGY: PROPERTIES OF OBJECTS

RATIONALE: Through the use of process skills, and their five senses, children will identify objects, and will observe and describe changes in the properties of the objects around them.

MAIN CONCEPT(S): All objects exhibit properties which can be used as a basis of identification and comparison. The changes occur when the properties of objects (matter) are modified.

*Refers to problem-solving
**Refers to STS
***Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Objects exhibit a number of properties.	a) Describe the difference between two or three objects using one property such as size, color or shape.	NOTE: Have labels for all the properties prepared and display them on a wall as you introduce each one. Have students bring in objects which fit under each property. Have a variety of objects on display that show a specific property such as size and color. e.g. Lego blocks in red can be different sizes. Lego blocks of one size can be different colors.
2. Properties of objects can be determined through a variety of senses.	a) Develop an awareness of safe ways to use the senses to test properties.	This can be integrated with health safety.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	b) Identify and describe objects in terms of observations made with the sense of: i) touch ii) sound they make iii) taste iv) smell v) sight	Use collections of pine cones, bark, rocks, seeds and pods to explore different textures in mystery bags for one child to describe and others to identify. Objects such as wood, sandpaper, styrofoam, metal washers, cotton batting can also be used. Coffee tins or margarine tubs can be used in place of bags. Compare sounds on the basis of loud/soft, high/low, near/far. (Use the mystery tins). Use lemons, a sugar cube, chocolate and salt to identify sweet/sour/salty. SAFETY Check for children's allergies. Caution them to taste things when an adult approves. Provide drinks of water to remove the taste. Use cotton balls soaked in peppermint extract, lemon juice, and banana extract. Also use coffee granules and orange juice crystals. Place each item in a small yogurt container; put a piece of nylon stocking over the opening and secure with a rubber band. Have students waft the aroma to their nose with their hand and then identify the item using their sense of smell. Pop some popping corn. Have students identify how the popcorn looks, smells, feels and tastes.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
3. Objects (matter) have other properties that identify them. i) Colour	a) Observe and identify the colour of an object.	Use paper shapes such as squares, circles, triangles, crayons, food colouring and pictures to introduce colour as a property. Identify familiar objects, such as traffic signs, by colour. Experience with an eye dropper and food colouring to make new colour in a jar of water.
	b) Classify various classroom objects by colour.**	Examine some objects such as lego blocks or crayons and group them according to color. Group squares or circles of paper, according to color. Have students group themselves according to colors which they are wearing e.g. running shoes, pants etc.
	c) Develop an awareness of a simple bar graph.	Have students make a bar graph using lego pieces or crayons. Provide them with the lines on paper and let them arrange the colored pieces. Discuss their creations with them.
ii) Shape	a) Observe and compare objects on the basis of 2-dimensional shapes.	Have examples of different shapes such as circles, triangles, and squares available in cardboard or paper. Have students identify objects, in the room, which have these shapes and name them. Play "I spy": Name the squares, triangles, etc. in the classroom. e.g. clock, door, etc.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	Infer the shape of objects on the basis of touch.	Use feely cans of objects such as wooden blocks, squash balls, pencils, metal washers, etc. that have a distinct shape and have the students identify the shapes. **Show students that things are often identified by shape (stop signs, hospital signs, etc.). **Show students the symbols that are used to identify hazardous materials.
iii) Size	a) Observe and compare objects on the basis of size.	Introduce the terms larger than, smaller than, and the same by using objects of identical shapes in various sizes (attribute blocks, tiles). Have box containing a variety of objects. Lift out each one and have the students decide which group the object fits into.
iv) Texture	a) Observe and compare objects on the basis of texture.	Display a variety of materials in pairs so objects can be compared as to smoothness and roughness. i.e.) smooth paper/sand paper, wool/satin, varnished wood/rough wood. Make texture books using scraps of paper and materials. Make texture rubbings - make a texture mural.
v) Hardness	a) Observe, compare and order objects on the basis of hardness.	Compare a variety of objects by hardness/softness, i.e., coins, washers, crayons, fabric, sponge, plasticine. Order from softest to hardest. This can be done by scratching with a penny or by feeling with the fingers. Keep the Number of objects under five.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
vi) Weight	a) Observe, compare and order objects in terms of their weight.	Fill 2 milk cartons with different amounts of same material. Have students lift each one and compare them using the terms heavy and light. Fill 5 milk cartons with different materials and order from lightest to heaviest. Tell children the contents and see if they can guess what is in each milk carton. Introduce a simple balance. It should be with a fixed pan (not swinging) and no scale gradient. Observe what happens when objects having identical or different weight are use.
4. Objects can be identified by physical properties.	a) Identify and describe objects in terms of properties.	Name specific properties of objects and have students identify objects i.e. find an object that is blue.
	b) Identify the basis on which sets of objects are classified.	Have students group objects by one property (colour, size, shape) and identify the property.
	c) Classify objects on the basis of two properties.	Have students group objects by colour and size; size and shape; shape and colour.
5. Objects can be compared, ordered and classified according to the degree to which they possess a single property.	a) Compare and order a pair of objects on the basis of: i) size ii) length iii) width iv) weight v) texture vi) hardness	Take 3 different-sized objects and demonstrate order from small to large and large to small. Have students perform the same task using other sets of objects. . Short to long. . Narrow to wide. . Light to heavy. . Smooth to rough. . Soft to hard. . Small to big.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
		FOR EXAMPLE: Provide the students with a short straw and a long straw and have them decide which is longer and which is shorter. Then use three straws and have them order them in sequence. ENRICHMENT Have children classify collections in their homes, for example things on walls. Have them share results.
6. Change occurs where the properties of objects (matter) are modified.	a) Observe and identify changes in properties such as shape, size, and colour.	Put such things as confetti, crushed potato chips, grated carrot, crushed sugar cube, pencil shavings in separate containers. Keep samples of the original objects and have students match the objects in the containers to the whole objects. Take a flat piece of aluminum foil and bend it into a circular form. Add orange juice crystals to water.
	b) Describe how many objects are changed through manufacturing.** ***	Visit local manufacturing plants such as a sawmill, flour mill, processing plants, bakery, restaurant, etc.
	c) Describe evidence of change in form and colour.	Give 2 colours of plasticine and have students describe changes when mixed, rolled, flattened, broken into pieces. Mix 2 colours of paint and describe the change.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	d) Observe and identify objects that have had properties changed.**	Place moistened bread, pieces of apple, and concentrated sugar solutions in separate containers and observe them periodically over a period of a week. Identify the changes which occur. SAFETY Don't leave mold samples uncovered. Check for children's allergies. Observe rusted nails and non rusted nails. Observe a balloon which is inflated and deflated. Relate the popcorn activity to these objectives.
7. Weather can exhibit different kinds of change.	a) Observe weather changes.	Have the students keep a weather record for the week using criteria such as sunny/cloudy, windy/not windy, dry/rainy, cold/warm/hot. After a week, predict Saturday's weather. ENRICHMENT Allow students who wish, to predict the weather each day after the first week, or an entire week's weather. Have pupils keep a record of their predictions using pictures. S M T W T F S

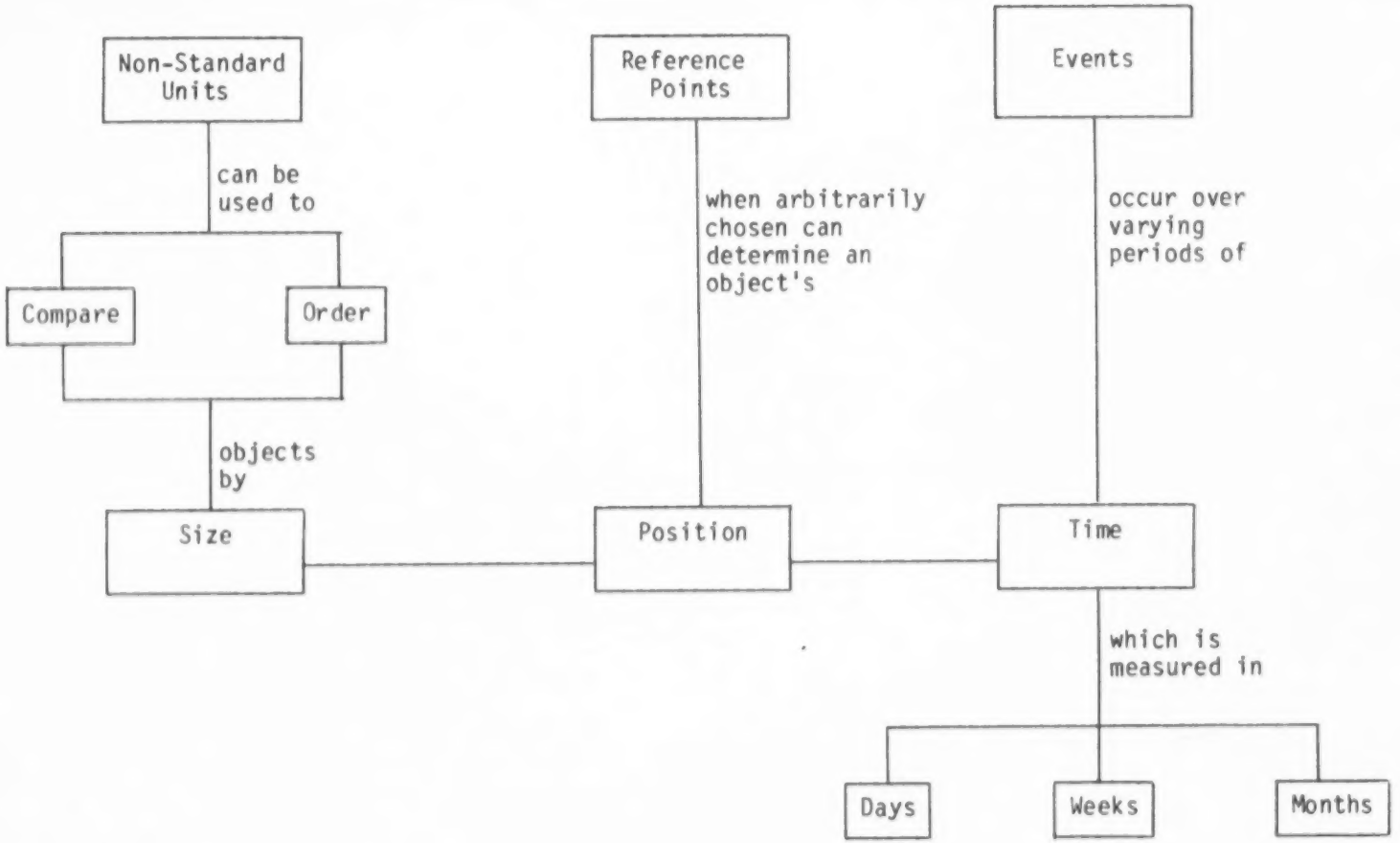
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES

Note: Emphasize that the basis for prediction is the important thing and not whether the prediction is correct.

Watch the TV weather forecast and check the **students' predictions.

KINDERGARTEN

EARTH, SPACE AND TIME: SIZE, POSITION AND TIME



KINDERGARTEN

TITLE: EARTH, SPACE, TIME: SIZE, POSITION, TIME

RATIONALE: Through the use of process skills children will develop an awareness of the passage of time in relation to their lives.

MAIN CONCEPT(S): Time can be measured in terms of short and long intervals and in terms of repetition of events.

* Refers to problem-solving
** Refers to STS
*** Refers to SDS

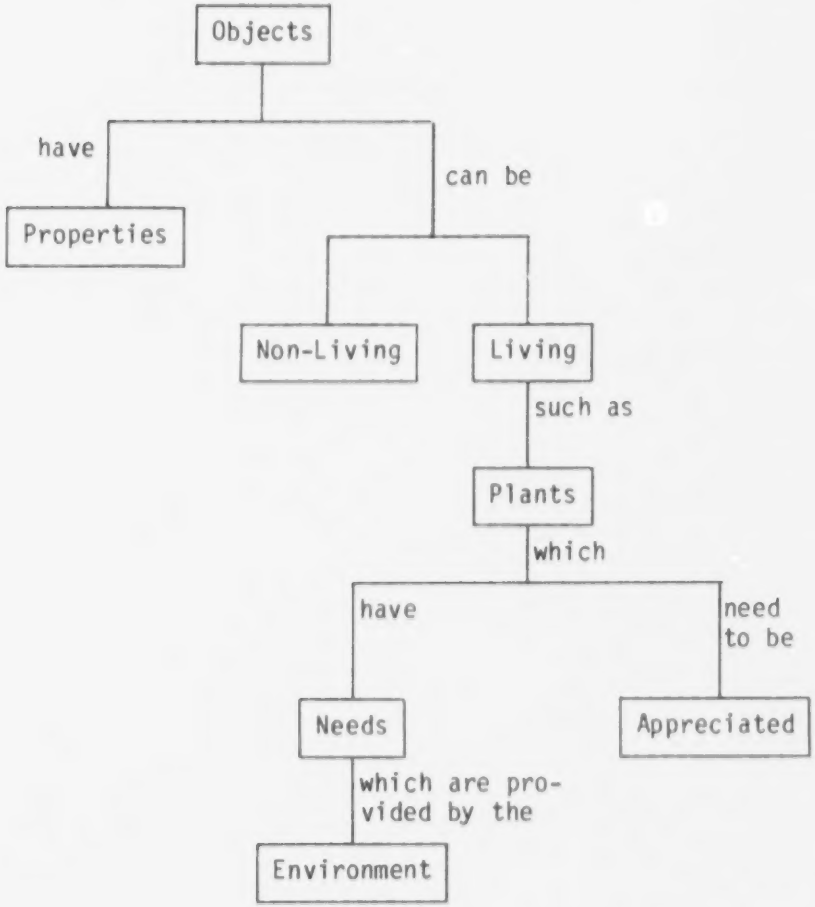
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Objects can be compared and ordered by size, using non-standard units.	a) Compare sizes as large/small.	Place the words big and small on a large chart. Brainstorm other words that mean the same. Brainstorm objects that fit under big and those that fit under small. Review larger than and smaller than from the previous unit. Have students match pictures with the headings big objects and small objects.
	b) Compare sizes of objects to different non-standard units.	Make cut-outs of each students right hand from construction paper. Measure objects in the room in groups of 2 or 3 using the cut-out hands of the group. Demonstrate how they are to do it. Objects could include their desk, their scrapbook, the window, door, sandbox, and so forth. They can measure their height by lying on the floor. Have a student sheet with drawings of the objects so students can record their number. A class chart can also be used.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Measure objects with non-standard units.	Measure items in the same fashion using toothpicks and then paper clips.
2. The position of an object is determined relative to arbitrarily chosen reference points.	a) Observe that the position of the object must be described. Use terms up/down, far/near, above/below.	Play I Spy using reference points and then have them guess the object. Play Position Bingo.
	b) Measure distance in non-standard units.	Have students measure the distance across the room using a skipping rope.
	c) Predict and record distances.	
3. Events occur over varying periods of time. They are of short or long duration.	a) Classify events in chronological order.	To show a series of events provide pictures of a seed sprouting, a young pine seedling, the large pin tree, the tree being cut, the sawmill, and a piece of furniture. Scramble them and have the students put them into chronological order.
	b) Observe the time of events.	Compare the time needed to zip vs button a jacket; tying shoe laces vs fastening velcro; crawling vs running across a room. Roll objects such as a marble, wooden block and a crayon down an incline.
	c) Observe and identify between long and short time intervals.	Use pictures to show the passage of time. For example: A seed sprouting and growing into a plant. Compare this to a melting ice cube.
	d) Classify an event as fast/slow.	Use pictures and classify by fast/slow. e.g. A melting crayon. Turning on a lamp, breaking a dish.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
4. Time is measured in days, weeks, months.	a) Observe the relationship between the passage of one day and the events that occur in that period.	Have students act out certain day-time and night-time events such as getting up, going to school, dinnertime, etc. Sequence these events.
	b) Identify the names of days in the week.	Do this in relation to the calendar.
	c) Observe the passage of one week and events that occur in that period.	Make a picture book. Make a monthly calendar with student's birthdays, the weather, and school events.
	d) Observe the relationship between the passage of one month and events that occur in that period.	Study the seasonal changes occurring. Make a game with a picture for each season and smaller pictures which may be classified.

KINDERGARTEN

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIVING AND NON-LIVING



KINDERGARTEN

TITLE: INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIVING AND NON-LIVING

RATIONALE: Through the use of process skills, children will develop an awareness of living and non-living things and recognize that the environment provides essential elements that sustain life.

MAIN CONCEPT(S): Objects are living or non-living. Plants are living organisms and require certain things to grow. The environment provides certain basic necessities.

TEACHER NOTE: This is an on-going unit, as growth of plants is slow. Do several concepts at one time.

* Refers to problem solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Objects have certain properties which help to identify them.	a) Observe, describe, explore and classify objects according to their properties re: size, colour, shape.	Play "I Spy" by describing an object's properties. Use "feely" bags/boxes. Students describe what they are feeling.
2. Objects are living or non-living. . living: a) need food and water; b) grow; c) die; d) reproduce.	a) Observe live objects and discuss their charateristics.**	Make and/or take care of a terrarium or acquarium. Have a group take care of an acquarium that is filtered or non-filtered. A list of necessary items can be compiled from simple science books with the teacher's help. Pictorial instructions should be made.
	b) Operationally define living objects.	Make the students aware that when an object takes in food and water it is alive.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Infer that plants and animals are living objects.***	ENRICHMENT Take a photo of a complete terrarium. Have students remove one living organism per day. compare to the original state after several days. Take another photo at this time. Infer as to the long range effects in the environment.
. non-living: a) do not need food or water;	a) Operationally define non-living objects.	Have the students being various objects to school. Label a specified area with "living, non-living" and allow students to classify the objects that they bring in. Make the students aware that if an object does not need food and water it is non-living.
b) do not grow;	b) Compare living and non-living objects on the basis of growth, need for food and water, and reproduction.	List the properties and discuss how living and non-living differ.
c) do not die;	c) Classify living and non-living objects.	Classify a set of living and non-living objects within the class/school and explain why each object is in its group.
d) do not reproduce;	d) Recognize that some non-living objects were previously living objects.	Compare objects such as wood, leaves, coral, natural sponges, and types of leather.
3. Plants are living organisms.	a) Recognize and identify plants from samples and pictures.	Compare and discuss plants that grow in the garden or in the wild and those in the house, or school yard.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	b) Compare plants with non-living objects.	Discuss properties of plants (living) and compare to non-living green things and objects with other properties.
	c) Observe and recognize that plants come from seeds and bulbs.	Plant several seeds and bulbs and observe growth. See 4(f).
	d) Classify different types of seeds and bulbs as to colour, texture, shape, size.	
4. Plants require certain things to grow.	a) Observe and chart what a plant needs to help it grow.	Use needs such as sunlight, water and air. Record ideas on chart paper.
	b) Observe the differences between dry seed and seeds soaked in water.	Soak bean seeds overnight in water. Observe the differences between these and dry seeds, using a magnifying glass.
	c) Observe the embryo in a seed and describe what is found inside the soaked bean.	After observation, have students plant the beans in paper cups filled with soil, one per child.
	d) Observe the growth of a bean and the number of leaves growing.**	Record the growth on a graph using strips of paper that correspond to the bean growth each day. Use the rip off edges of computer paper. Keep a booklet that pictorially shows the number of leaves.
	e) Observe, the growth of plants from bulbs.	Graph the growth of bulbs such as onion, tulip, or narcissus.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	f) Observe that different plants have different characteristics during their stages of development.	Encourage students to bring seeds or vegetables such as potatoes and carrots for planting. SAFETY Check for students' allergies. All plants must be kept away from the mouth and nose.
	h) Observe that man can affect the growth of plants.**	Test the effects of fertilizer on plant growth (teacher demonstration). Test overcrowding. Test different soil types.
	i) Recognize occupations related to plants.**	Have students select the following occupations from pictures: nursery, florist, farmer and conservationist.
5. The environment provides basic necessities such as soil, water and energy from the sun.	a) Describe what we receive from the environment in order to live.**	Brainstorm such things as the sun, water, air, soil for planting food crops.
	b) Observe what happens to a plant with:* . no sun; . no water; . no sun or water.	Keep milk carton or styrofoam cups, earth, seeds handy. Allow students to carry out their own experiments.
6. People need to develop an appreciation for living things.	a) Develop an appreciation for living things.*** **	Carry out discussion and/or field trips.

RESPONSE QUESTIONNAIRE FOR K-9 SCIENCE PROGRAM OF STUDIES

Please return this questionnaire by January 15, 1992 to the:

Science Consultant
Curriculum Services
Manitoba Education and Training
411-1181 Portage Avenue
Winnipeg, Manitoba R3G 0T3

Please respond to each question in the space provided. (Attach extra sheets if more space is required). Use the page references when making specific comments.

1. Does the guide provide you with sufficient information as to nature and scope of the science program?

2. Are you able to adequately cover the stated objectives within the available class time?

3. Are your students capable of achieving the objectives listed in the unit(s)?

4. Is there sufficient variety in the activities to allow all students to take part in the program?

5. Which activities are too simple or too difficult for the intended grade level?

6. Which activities do not seem to work well?

...../2

7. Which activities require clearer directions?

_____

_____

8. Are there sufficient material resources in your school to enable you to adequately teach the program?

_____

_____

9. Is there difficulty in obtaining science materials in order to carry out the activities?

_____

10. Do the students enjoy or appreciate the program?

_____

_____

11. What are some specific features of the program with which you are pleased?

_____

_____

12. Within the framework of the revised program, please make suggestions which, in your opinion, may result in significant improvements.

_____

_____

_____

_____

_____

NAME: _____ SCHOOL: _____

GRADE: _____ PHONE: _____

THANK YOU FOR YOUR ASSISTANCE.